

REMARKS

The August 1, 2001 Official Action and the references cited therein have been carefully considered. In view of the amendments presented herewith and the following remarks, favorable reconsideration and allowance of this application are respectfully requested.

At the outset, it is noted that a shortened statutory response period of three (3) months was set forth in the August 1, 2001 Official Action. The initial due date for response, therefore, was November 1, 2001. A petition for a one (1) month extension of the response period is presented with this response, which is being filed within the one (1) month extension period, as December 1, 2001 fell on a Saturday.

In the August 1, 2001 Official Action, claims 1-18 stand rejected under 35 U.S.C. §112, second paragraph as allegedly indefinite. The Examiner has rejected all claims based on the recitation of "between surfactant hydrophobic groups" in claim 1. Also in this connection, the Examiner has noted misspellings of certain terms in claims 8, 11 and 15.

Claims 1-18 are further rejected under 35 U.S.C. §103(a) as allegedly obvious based on the combined disclosures of U.S. Patent No. 5,410,016 to Hubbell et al. (hereinafter "Hubbell"), U.S. Patent No. 5,112,611 to Ahmad et al. (hereinafter "Ahmad"), U.S. Patent No. 5,531,917 to Nakayama et al. (hereinafter "Nakayama") and U.S. Patent No. 5,171,737 to Weiner et al. (hereinafter "Weiner"). According to the Examiner,

it would have been *prima facie* obvious to one of ordinary skill in the art at the time the present invention was made to deliver papain using the biodegradable hydrogels of Hubbell to achieve the beneficial effect of aiding human digestion, as purportedly suggested by Ahmad, and to add surfactants to achieve the beneficial effect of stabilizing the enzyme, as purportedly suggested by Nakayama. The Examiner further contends in this connection that the claimed complex would inherently form during mixing of the components to make the composition allegedly suggested by the cited prior art references.

Regarding the claimed non-ionic surfactants, the Examiner asserts that one of ordinary skill in the art would use dioleoyl phosphatidylethanolamine (DOPE) or dioleoyl phosphatidylcholine (DOPC) because of their utility for delivering bioactive agents, as purportedly suggested by Weiner.

Claims 2-5, 7-12 and 14 and 15 have been provisionally rejected under 35 U.S.C. §101 as allegedly claiming the same invention as that of claims 3-14 in applicants' co-pending Application No. 09/445,656 (hereinafter the '656 application).

Claim 1 has also been provisionally rejected on the ground of obviousness-type double patenting based on claim 1 of the '656 application.

In addition to the above-noted rejections, the Examiner has required submission of an abstract on a separate sheet, as required by 37 C.F.R. §1.72(b).

The aforementioned rejections and objection constitute the only grounds set forth in the August 1, 2001 Official Action for refusing allowance of this application.

In accordance with the present amendments, claims 8 and 14 have been amended to correct the misspellings noted by the Examiner. It is assumed that claim 14 is intended to be rejected under §112, second paragraph, and not claim 15, as claim 14 includes the misspelled terms referred to at the bottom of page 2 of the August 1, 2001 Official Action. Those terms do not appear in claim 15. A review of claim 11 does not show the typographical error ("dioloeyl") referred to at page 3 of the August 1 Official Action. Accordingly, claim 11 has not been amended.

Also in accordance with the present amendments, an "Abstract of the Disclosure", in conformity with the requirements of 37 C.F.R. §1.72(b), is submitted herewith.

No new matter has been introduced into this application by any of the amendments presented herewith. Moreover, none of the present claim amendments are believed to constitute a surrender of any originally claimed subject matter in order to establish patentability.

For the reasons set forth below, applicants respectfully submit that each of the substantive grounds of rejection set forth in the August 1, 2001 Official Action is factually or legally deficient, or both. Those grounds of rejection are, therefore, respectfully traversed.

A. Claims 1-18 Fully Comply with the Definiteness Requirement of 35 U.S.C. §112, Second Paragraph

The relevant inquiry in determining compliance with the definiteness requirement of 35 U.S.C. §112, second paragraph, is whether the claim in question sets out and circumscribes a particular area with a sufficient degree of precision and particularity, such that the metes and bounds of the claimed invention are reasonably clear. In re Moore, 169 U.S.P.Q. 236 (C.C.P.A. 1971).

The definiteness of claim language may not be analyzed in the abstract, but must be considered in light of the supporting specification, with the language in question being accorded the broadest reasonable interpretation consistent with its ordinary usage in the art. In re Morris, 44 U.S.P.Q.2d 1023, 1027 (Fed. Cir. 1997). See also Ex parte Cole, 223 U.S.P.Q. 94 (Bd. Apps. 1983) (claims are addressed to the person of average skill in a particular art; compliance with §112 must be adjudged from that perspective, not in a vacuum)..

Furthermore, it has long been held that the initial burden of establishing a failure to comply with 35 U.S.C. §112, second paragraph, rests upon the Examiner. In rejecting a claim for alleged indefiniteness, therefore, it is incumbent upon the Examiner to establish that one having ordinary skill in the art would not have been able to ascertain the scope of protection defined by the claim when read in light of the supporting specification. Ex parte Cordova, 10 U.S.P.Q.2d 1949, 1952 (PTO B.P.A.I. 1988).

When the appropriate procedural approach is followed in assessing the claim terminology at issue herein, in accordance with the above-noted authorities, it is beyond question that applicants have satisfied the definiteness requirement of §112, second paragraph, with respect to the subject matter of claims 1-18.

The claim recitation in question ("between surfactant hydrophobic groups") refers to the cooperative stabilization of the supramolecular complex of the invention resulting from the interaction between the hydrophobic groups present on the charged surfactant, which constitutes one of the components of the complex. "Surfactant" and "hydrophobic groups" are terms of art, the meanings of which are well understood by those of ordinary skill in the art. Grant & Hackh's Chemical Dictionary, 5<sup>th</sup> Ed., at 564 (copy attached) provides the following definition of surfactant:

A surface-active agent; i.e., one that modifies the nature of surfaces, this often involving reducing the surface tension of water.

"Hydrophobic" and "group" are defined at pages 293 and 270, respectively, of Grant & Hackh's Chemical Dictionary, 5<sup>th</sup> Ed. (copies attached). "Hydrophobic" describes a substance that does not adsorb or absorb water. "Group" is an alternative expression for "radical". Applicants respectfully submit that these definitions establish the broadest reasonable meaning that can be ascribed to the expression "between surfactant hydrophobic groups," based on ordinary usage as understood by those of

ordinary skill in the art.

Furthermore, when the challenged claim recitation is properly considered in light of the specification, it cannot reasonably be considered vague. Directing attention to page 11, lines 27-35, it is disclosed that the interactions of hydrophobic groups of surfactant molecules with each other contribute to cooperative stabilization of the ionic complexes formed between the block copolymers and surfactants of the opposite charge, which make up the composition of the invention. The phenomenon referred to in the present specification as "cooperative stabilization" is further explained at pages 26-27 of the present specification. Thus, applicants' disclosure clearly indicates that stabilization of the supramolecular complexes of the invention is the result of the aggregate effects of the interaction between the opposite charges of the block copolymer and the surfactant, as well as the interaction between the hydrophobic groups present on the charged surfactant.

In summary, applicants' position with respect to the rejection of claims 1-18 based on 35 U.S.C. §112, second paragraph, is that any person skilled in the art, having applicants' disclosure and claims before him or her, would be apprised, to a reasonable degree of certainty, as to the exact subject matter encompassed within claims 1-18. Nothing more is required under 35 U.S.C. §112, second paragraph.

For the foregoing reasons, it is clear that, in the present case, the Examiner has failed to satisfy her burden of

proof with respect to the §112, second paragraph, rejection of claims 1-18 as set forth in the August 1, 2001 Official Action. Accordingly, this ground of rejection is improper and should be withdrawn.

B. The Combined Disclosures of Hubbell, Ahmad, Nakayama and Weiner Fail to Render Obvious the Subject Matter of Claims 1-18

Applicant respectfully submits that the various references applied against claims 1-18 in the August 1, 2001 Official Action fail to establish a *prima facie* case of obviousness. According to M.P.E.P. § 2143,

[t]o establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

**The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.**

(Emphasis added.)

The present invention is directed to a composition for delivery of biological agents which comprises a therapeutic or diagnostic agent and a supramolecular complex which includes as constitutes (1) a block copolymer having at least one nonionic, water soluble segment and at least one polyionic segment and (2)

at least one charged surfactant having hydrophobic groups. The claims specify that the charge of the surfactant component is opposite to the charge of the polyionic segment of the block co-polymer component. The claims further recite that the composition is bound by the interaction between (i) the opposite charges of the block co-polymer and surfactant components and (ii) the hydrophobic groups of the surfactant.

Unlike the supramolecular complex-containing composition of the present invention, Hubbell relates to photopolymerizable, biodegradable hydrogels which are purportedly useful as controlled release carriers, among other things. The hydrogels of Hubbell have fundamentally different structures as compared to the block co-polymers utilized in applicants' invention. "Hydrogel", as defined in Grant & Hackh's Chemical Dictionary 5<sup>th</sup> Ed., at 291 (copy attached), is a water-swellable, rigid, three-dimensional network composed of cross-linked hydrophilic molecules. The cross-linked nature of Hubbell's hydrogel is evidenced from both the specification and claims of the Hubbell patent. See Col. 8, lines 8-12 and Claim 1, lines 5-7. The presence of cross-linked or entangled polymer chains inhibits diffusion of the hydrogel polymer chains in solution. Block co-polymers, on the other hand, as called for in applicants' claims are not cross-linked or otherwise entangled and are free to diffuse in solution. The structure of block co-polymers is illustrated in L.H. Sperling, Introduction to Physical Polymer Science, J. Wiley & Sons, New York, NY (1992).

ARGUMENTS  
THIS IS NOT A  
BLOCK CO-POLYMER

at 46-47, (copy attached).

(3) Ahmad describes a pharmaceutical composition for aiding human digestion which includes papain, hyssop and grapefruit extract, as active agents, blended together, in preferred embodiments, with a gum base. There is no reason to infer from the disclosure of Ahmad that any benefit would be obtained from incorporating the pharmaceutical composition described therein in a controlled release carrier of the type described by Hubbell.

(4) Nakayama relates to a method for stabilizing an agent for contact lens cleaning and sterilization containing a proteolytic enzyme, such as papain among others, by the addition of a surfactant selected from the group of anionic surfactants, amphoteric surfactants and nonionic surfactants. Those of ordinary skill in the art would not consider a disclosure relating to contact lens agents as being of any assistance where, as in this case, a polymer-based composition for facilitating delivery of biological agents is desired.

(5) Weinert relates to non-toxic, parenteral emulsions for delivery of a bioactive agents, such as drugs, imaging agents or diagnostic agents. According to one embodiment, a water and oil emulsion is provided which comprises a first HLB requirement amount of primary surfactant DOPE, which may further include a second HLB requirement amount of a second surfactant, such as DOPC. As neither Hubbell, nor Ahmad nor Nakayama relate to parenteral emulsions, there is no reason to incorporate a nonionic surfactant, such as DOPE and DOPC, in the compositions

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R&G marks (off patent)  
T-656

disclosed in any of those references in order to impart a wider range of HLB values, which is the stated objective of Weiner. (See Col. 2, lines 10-14).

Regarding the first criterion of *prima facie* obviousness, i.e., suggestion or motivation to combine the cited prior art disclosures, the present case has notable similarities to Ex parte Levengood, 28 U.S.P.Q.2d 1300 (B.P.A.I. 1993). In reversing a §103 rejection based on a combination of prior art references, the Board in Levengood stated, at 1302:

...[A]n examiner cannot establish obviousness by locating references which describe various aspects of a patent applicant's invention without also providing evidence of the motivating force which would impel one skilled in the art to do what the patent applicant has done.

Here, as in Levengood, the references cited as evidence of obviousness fall far short of providing the "motivation" or "suggestion" to assemble their teachings into a viable invention.

6 There is certainly no motivation apparent from the cited references themselves for combining a block copolymer, having at least one nonionic, water soluble segment and at least one polyionic segment, with at least one charged surfactant having hydrophobic groups, such that the charge of the surfactant is opposite to the charge of polyionic segment of the block copolymer, to form a supramolecular complex useful for delivery of biological agents. Consequently, the first criterion for a case of *prima facie* obviousness has not been established.

*2nd criterion*

As for the reasonable expectation of success (criterion), since none of the references of record even remotely suggest applicants' composition for facilitating delivery of biological agents, comprising a therapeutic or diagnostic agent and a supramolecular complex of a block copolymer, having at least one non-ionic, water soluble segment and at least one polyionic segment, and at least one charged surfactant having hydrophobic groups, with the charge of the surfactant being opposite to the charge of the polyionic segment of the block copolymer, it necessarily follows that the prior art does not provide the requisite reasonable expectation of success.

(7)

Turning to the third criterion of the prima facie case, the references proposed to be combined in support of this ground of rejection clearly fail to teach or suggest all of applicants' claim recitations. As previously noted, there is no disclosure or suggestion in any of the cited references of a composition for delivery of biological agents having a block copolymer with at least one nonionic, water soluble segment and at least one polyionic segment as a component thereof. Nor is there any appreciation evidenced in any of the cited references that the charge of the surfactant component is opposite to the charge of the polyionic segment of the block copolymer. On the contrary, according to Nakayama, nonionic surfactants, anionic surfactants or amphoteric surfactants made be used interchangeably for the purpose of stabilizing the proteolytic enzyme-containing contact lens agents described therein. Such disclosure unquestionably

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fails to render obvious applicants' claims that call for the combination of a block copolymer which has a polyanionic segment with a cationic surfactant having hydrophobic groups. See, for example, claim 5 and the claims dependent therefrom.

Moreover, there is nothing in the prior art references cited in support of this obviousness rejection to suggest the modifications thereof that would be necessary to satisfy all of the recitations of applicants' claims. Such modifications would include, at a minimum, substituting a block copolymer for the hydrogels of Hubbell. However, hydrogels having cross-linked polymer chains are an essential aspect of the Hubbell invention. It is well established that a patent disclosure cannot properly be modified if the effect would be to destroy the invention on which the patent is based. Cf. Ex parte Hartman, 186 U.S.P.Q. 366 (Bd. Apps. 1974). Likewise, there is no teaching or suggestion in any of the cited references that would provide incentive for combining a block copolymer comprising at least one polyionic segment with a surfactant having hydrophobic groups and a charge which is opposite to that of the polyionic segment of the block copolymer, thereby resulting in supramolecular complexes formed due to interactions between such opposite charges and the hydrophobic groups of the surfactant.

For all of the above reasons, the combined disclosures of Hubbell, Ahmad, Nakayama and Weiner fail to provide a proper basis for concluding that the present invention is prima facie obvious.

Given that the prior art references cited in support of the §103(a) rejection of claims 1-18 fail to teach or suggest the claimed subject matter as a whole, no evidence of surprising or unexpected result need be presented. In re Lunsford, 148 U.S.P.Q. 721 (C.C.P.A. 1966).

The obviousness rejection set forth in the May 22, 2001 Official Action is a clear case of hindsight reconstruction of the claimed invention. It is quite apparent that the Examiner has used applicants' disclosure as a guide for combining unrelated prior art teachings in an effort to make out a case of obviousness. Such hindsight reconstruction has long been held impermissible, since it is contrary to the standard of obviousness set forth in 35 U.S.C. §103, which requires a determination of whether the claimed subject matter as a whole would have been obvious at the time the invention was made, based on the state of the art as reflected in the cited references, and without benefit of applicants' disclosure. None of the diverse references relied on by the Examiner in formulating the §103 rejection in this case contains the slightest suggestion to use what is disclosed in one reference in combination with what is disclosed in the other references. Cf. In re Avery, 186 U.S.P.Q. 161 (C.C.P.A. 1975). That being the case, it cannot reasonably be maintained that the combined disclosures of Hubbell, Ahmad, Nakayama and Weiner fairly suggest doing what the applicant has done. Accordingly, the rejection under 35 U.S.C. §103 based on the combination of these four (4) references is

(only 3 refs.)?

improper. In re Shaffer, 108 U.S.P.Q. 326 (C.C.P.A. 1956).

C. The 35 U.S.C. §101 Double Patenting Rejection of Claims 2-5, 7-12, 14 and 15 is Improper and Should be Withdrawn

A "same invention" double patenting rejection under 35 U.S.C. §101 is proper only when the applicants are attempting to twice claim identical subject matter. Because there are embodiments of applicants' invention that fall within the scope of the claims of the co-pending '656 application, but not within the scope of claims 2-5, 7-12, 14 and 15 of the present application, it is clear that applicants are not attempting to claim identical subject matter twice. It is significant to note in this regard that the claims identified as allegedly violating §101 are all dependent claims. As such, these claims must be construed to incorporate by reference all the limitations of the claims to which they refer. When properly construed, the claims of the present invention, which are drawn to a composition comprising a therapeutic or diagnostic agent and a two component supramolecular complex, as noted above, could be literally infringed without literally infringing corresponding claims in the '656 application, which do not call for a therapeutic or diagnostic agent in combination with the aforementioned supramolecular complex.

*101 D.P.  
argues that  
no 101 D.P.*

In view of the clear difference in claim scope between the respective applications, statutory double patenting does not exist in the present case. See §804 of the Manual of Patent

Examining Procedure (M.P.E.P.).

D. A Provisional Obviousness-Type Double Patenting Rejection is Inappropriate in the Present Case Because the Effective Filing Date of the Application on Which the Rejection is Based is the Same as the Present Application

As noted in M.P.E.P. §804, an obviousness-type double patenting rejection is grounded in public policy so as to prevent the unjustified or improper timewise extension of the right to exclude granted by a patent. In this case, however, there is no opportunity for unjustified or improper timewise extension of exclusive patent rights. Both of the applications in question have the same effective filing date, i.e. June 11, 1998. Thus, if patents were granted on these applications, the patent terms would expire on the same date. That being the case, there is no basis for an obviousness-type double patenting rejection in the present case.

*Appl.  
not filing  
aTD*

In any event, if the Examiner is inclined to maintain this ground of rejection, it is hereby requested that it be held in abeyance until such time as it is the only rejection remaining in the application, whereupon it should be withdrawn so that either the present application or the '653 application may be passed to issue, with the provisional double patenting rejection being converted to a non-provisional double patenting rejection in the other application, as authorized by §804 of the M.P.E.P.

The Examiner is correct in assuming at page 6 of the August 1, 2001 Official Action, that the subject matter of the

various claims was commonly owned at the time the invention covered thereby was made.

In view of the foregoing remarks, it is respectfully urged that the rejections and objection set forth in the August 1, 2001 Official Action be withdrawn and that this application be passed to issue and such action is earnestly solicited.

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PJH:ksk  
Enclosures



#### ABSTRACT OF THE DISCLOSURE

A composition for facilitating delivery of biological agents, comprising a therapeutic or diagnostic agent and a supramolecular complex, the latter comprising (i) a block copolymer, having at least one nonionic, water soluble segment and at least one polyionic segment, and (ii) at least one charged surfactant having hydrophobic groups. The charge of the surfactant is opposite to the charge of the polyionic segment of the block copolymer. The constituents of the supramolecular complex are bound by interaction between the opposite charges thereof and between surfactant hydrophobic groups. The therapeutic or diagnostic agent may be an ionic substance, in which case the ionic substance has a net charge opposite to that of the block copolymer, the net charge being no more than 10.



MARKED-UP VERSION OF AMENDED CLAIMS

8. (Amended) A composition as claimed in claim 4, wherein said polyanionic segment is a homopolymer or a co-polymer prepared from a monomer which polymerizes to form a product with carboxyl pendant groups, said monomer being selected from the group consisting of acrylic acid, [aspartic] aspartic acid (amino acid), 1,4-phenylenediacrylic acid citraconic acid, citraconic anhydride, trans cinnamic acid, 4-hydroxy-3-methoxy cinnamic acid, p-hydroxy cinnamic acid, trans-glutaconic acid, [glutamine] glutamic acid (amino acid), itaconic acid, linoleic acid, linolenic acid, methacrylic acid, maleic acid, maleic anhydride, mesaconic acid, trans- $\beta$ -hydromuconic acid, trans-trans muconic acid, oleic acid, ricinoleic acid, 2-propene-1-sulfonic acid, 4-styrene sulfonic acid, trans-traumatic acid, vinylsulfonic acid, vinyl phosphate acid, vinyl benzoic acid, vinyl glycolic acid.
14. (Amended) A composition as claimed in claim 12, comprising an anionic surfactant selected from the group consisting of alkyl sulfates, alkyl sulfonates, fatty acid soaps, salts of hydrox-, hydroperoxy-, polyhydroxy-, epoxy- fatty acids, salts of mono- and polycarboxylic acids, prostanoic acid and [prostaglandines] prostaglandins, [leukotriens] leukotrienes and lipoxines, alkyl phosphates, alkyl phosphonates, lipids, sodium-dialkyl sulfosuccinate, n-alkyl ethoxylated sulfates, cholate and desoxycholate of bile

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salts, perfluorocarboxylic acids, fluoroaliphatic phosphonates, fluoroaliphatic suphates.

GRANT & HACKH'S  
**CHEMICAL  
DICTIONARY**

[*American, International, European and British Usage*]

*Containing the Words Generally Used in Chemistry,  
and Many of the Terms Used in the Related  
Sciences of Physics, Medicine, Engineering,  
Biology, Pharmacy, Astrophysics,  
Agriculture, Mineralogy, etc.*

*Based on Recent Scientific Literature*

FIFTH EDITION  
*Completely Revised and Edited by*

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TABLE 43. HYDROCARBON SERIES

	Formula
Alkanes*, paraffins, or methane series . . . . .	$C_nH_{2n+2}$
Alkenes*, olefins, or ethylene series . . . . .	$C_nH_{2n}$
Aalkynes*, acetylenes, or ethyne* series . . . . .	$C_nH_{2n-2}$
Terpenes* or alkones . . . . .	$C_nH_{2n-4}$
Benzenes and diacetylenes . . . . .	$C_nH_{2n-6}$
Phenylene series . . . . .	$C_nH_{2n-8}$
Indene series . . . . .	$C_nH_{2n-10}$
Naphthalene series . . . . .	$C_nH_{2n-12}$
Biphenyl series . . . . .	$C_nH_{2n-14}$
Stilbene series . . . . .	$C_nH_{2n-16}$
Anthracene series . . . . .	$C_nH_{2n-18}$
Fluoranthene series . . . . .	$C_nH_{2n-20}$
Pyrene series . . . . .	$C_nH_{2n-22}$
Chrysene series . . . . .	$C_nH_{2n-24}$
Binaphthyl series . . . . .	$C_nH_{2n-26}$
Perylene series . . . . .	$C_nH_{2n-28}$

hydrocarpic Misnomer for hydrocarpic.

hydrocellulose  $C_{12}H_{22}O_{11} = 342.3$ . A compound obtained from cellulose by prolonged treatment with concentrated acids.hydrocerulignone  $C_{16}H_{18}O_4 = 274.3$ . A solid, m.190, soluble in water.hydrochelidonic acid  $CO(CH_2 \cdot CH_2 COOH)_2 = 174.2$ . Acetonediacetic acid, 4-oxoheptanedioic acid\*. Crystals, m.142, soluble in water.

hydrochinone Hydroquinone\*.

hydrochlorate Hydrochloride.

hydrochloric acid  $HCl = 36.46$ . Muriatic acid. A solution of hydrogen chloride gas in water (NF, EP, BP). concentrated ~ Not less than 35% HCl. A clear, colorless, fuming liquid, d.1.18, used extensively as a reagent and in organic synthesis.

dilute ~ A solution of about 20% HCl. fuming ~ A solution of about 37% HCl, d.1.19. nitro ~ Aqua regia.

hydrochloride A salt of hydrochloric acid and an organic base, especially an alkaloid, usually more soluble than the base. It differs from chlorides in retaining the H atom; as, Alk-HCl.

hydrochlorothiazide  $C_7H_8O_4N_3ClS_2 = 297.7$ . White powder, m.267 (decomp.), insoluble in water; a diuretic (USP, BP). See *chlorothiazide*.hydrocinnamic acid  $Ph(CH_2)_2COOH = 150.2$ . 3-Phenylpropionic acid\*. Colorless needles, m.49, slightly soluble in water. amino ~ Phenylalanine.

aminohydroxy ~ Tyrosine\*. hydroxy ~ ortho ~ Melilotic acid. para ~ Phloretinic acid. methylene ~ Benzylacrylic acid.

hydrocinnamic aldehyde  $C_9H_{10}O_3 = 166.2$ .

3-Phenylpropanal\*. Colorless liquid, b.222, insoluble in water; used in organic synthesis.

hydrocollidine A ptomaine from putrefying fish.

hydrocoridine  $C_{10}H_{17}N = 151.3$ . A ptomaine produced by *Bacillus allii* or *Bacterium album* in agar cultures.hydrocortisone  $C_{21}H_{30}O_5 = 362.5$ . White crystals, m.214, insoluble in water. A hormone secreted by the adrenal cortex; used widely as the h. acetate and h. sodium succinate for intravenous injections and for skin conditions (USP). h. acetate  $C_{23}H_{32}O_6 = 404.5$ . White crystals, m.220, insoluble in water; used similarly to h. (USP, BP). See *corticoids*.hydrocotarnine  $C_{12}H_{15}O_3N = 221.3$ . An alkaloid from opium. Colorless crystals, m.53, insoluble in water; a hypnotic.hydrocotoxin See *hydrocotoxin* under *cotoxin*.hydrocoumaric acid  $C_9H_{10}O_3 = 166.2$ .

(Hydroxybenzene)propanoic acid. ortho ~ Melilotic acid. para ~ Phloretinic acid.

hydrocoumarone Hydrobenzofuran.

hydrocracking Conversion of inferior fuel oil fractions to more valuable fuels (as, jet and diesel) in the presence of catalysts and hydrogen.

hydrocupreine  $C_{19}H_{24}N_2O_2 = 312.4$ . An alkaloid from cuprea bark. methyl ~ Hydroquinine\*.hydrocyanic acid  $HCN = 27.03$ . Prussic acid, hydrogen cyanide\*, formonitrile. Colorless, very poisonous gas, with an almond odor; d.0.697, b.25, soluble in water. Used as a poison gas, in metallurgy and mining (cyanide process), and in organic synthesis.

hydrocyanide The salt of an organic base with hydrocyanic acid, containing the HCN molecule.

hydrodiffusion Diffusion into water.

hydrodynamics The study of the mechanical properties of liquids, especially water.

hydrodynamometer An instrument for measuring the velocity of a fluid in motion.

hydroextractor Hydro. A rapid centrifuge for drying or dehydrating crystals, textiles, etc.

hydroferricyanide Ferricyanic acid.

hydrofluorogermainic acid Fluorogermainic acid.

hydrofluoric acid\*  $HF = 20.00$ . Phthoric acid. A solution of hydrogen fluoride in water. A colorless liquid which must be kept in paraffin, rubber, or plastic bottles. Used to etch glass; and as a reagent. Its salts are the fluorides.hydrofluoride A salt of hydrogen fluoride and an organic base, usually an alkaloid. Cf. *fluoride*.

hydrofluosilicic acid Hexafluorosilicic acid\*.

hydroforming The cold forming of metal objects by pressure.

hydrofranklinite Chalcophanite.

hydrogel Water-swollen, rigid, 3-dimensional network of cross-linked, hydrophilic macromolecules (20-95% water).

Used in paints, printing inks, foodstuffs, pharmaceuticals, and cosmetics. Gelatin or starch can be used as a base.

hydrogen\* (1) History: H was probably first discovered in the 16th century by Paracelsus, and first investigated in 1766

by H. Cavendish, who later showed that water is produced when this gas burns (Greek νερό, "water," and γεννάω, "to produce"). Liquid and solid H were first prepared by Dewar in 1898. (2)  $H_2 = 2.016$ . Hydrogen gas. Colorless,inflammable gas, m. -259, b.-253, slightly soluble in water, alcohol, or ether. With the 3 isotopes H, D, and T, there are 6 possible molecular forms: HH, DD, TT, HD, HT, DT.  $H_2$  consists of ortho (symmetrical, alpha) and para (antisymmetrical, beta) forms, which differ slightly in physical properties owing to the different spin of their atomic nuclei.

The nuclei in the ortho form have parallel spins, and those in the para form have antiparallel spins. At 20°C, h. consists of 75% ortho and 25% para forms. Used as fuel in torches for cutting metals, welding, and melting; in the production of synthetic stones or gems, the annealing of steel, the

hydrogenation of oils, the cracking of hydrocarbons, and the production of synthetic ammonia. (3)  $H = 1.00794$ . The simplest element, at. no. 1. Hydrogen atoms, the basis of the valence system, being taken as unity. Elements combining directly with H atoms have a negative oxidation number;

elements replacing H have a positive oxidation number.

(4) Constants of H atom and molecule:

Mass of atom =  $1.662 \times 10^{-24}$  gRadius of molecule =  $10^{-8}$  cm

an equal number of  $\text{OH}^-$  ions,  $\text{pH}(7.0) + \text{pOH}(7.0) = \text{constant}$  (14.00). Accordingly, pH values 0-7 indicate an acid solution; pH 7 neutrality; pH 7-14 an alkaline solution. h.-i. conversion If h.-i. concentration  $c_{\text{H}^+} = a \times 10^{-b}$ ,  $\text{pH} = -b \log a$ . If  $\text{pH} = x \cdot yz$ ,  $c_{\text{H}^+} = [\text{antilog}(1 - yz/100)] \times 10^{-(x+1)}$ . h.-i. determination apparatus (1) Electrometric: Measures the potential of a H electrode (which depends on the pH of the solution) against standard calomel electrode. (2) Colorimetric: Compares the color of an indicator added to the solution with its color in a solution of known pH. h.-i. indicator A dye that has definite colors at different pH values. See *indicator*. h.-i. recorder An automatic potentiometer for recording and controlling the acidity and alkalinity of solutions; used in industry.

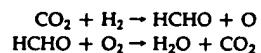
**hydrogenite** A mixture: silicon 25, sodium hydroxide 60, slaked lime 15%; ignites on burning to give 270-370 L/kg of hydrogen gas.

**hydrogenium** A volatile, metallic element of which H is the supposed vapor.

**hydrogenize** To hydrogenate.

**hydrogenolysis** The cleavage of a C-C or C-O bond accompanied by the addition of  $\text{H}_2$ ; as,  $\text{R}-\text{R}' + \text{H}_2 \rightarrow \text{RH} + \text{R}'\text{H}$ . Cf. *hydrogenation*.

**hydrogenomonas** A genus of bacteria occurring in the soil and oxidizing hydrogen gas to form water by catalytically reducing carbon dioxide:



**hydroginkolic acid** Cyclogalliphatic acid.

**hydrohaeterolite** The mineral  $2\text{ZnO} \cdot 2\text{Mn}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

**hydrohalic** Composed of hydrogen and halogens.

**hydrohematite**  $2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . A crystalline, hydrated mineral.

**hydrohydrastine**  $\text{C}_{11}\text{H}_{13}\text{O}_2\text{N} = 191.2$ . An alkaloid, from hydrastine, m.66, soluble in alcohol.

**hydroiodide** Hydriodide. A compound, usually an alkaloid, combined with hydrogen iodide.

**hydrokinetics** The science of the motion of fluids under a force.

**hydrol** See *hydrone theory*.

**hydrolapachol** A hydroxynaphthoquinone, m.93, used as an acid-base indicator (colorless to red at pH 5 to 6).

**hydrolase\*** See *enzymes*, Table 30.

**hydrolith** Calcium hydride\*.

**hydrolysis** A decomposition reaction caused by water,  $\text{AB} + \text{H}_2\text{O} = \text{AOH} + \text{B}$ , which, in its ionic form,  $\text{H}_2\text{O} = \text{H}^+ + \text{OH}^-$ , is the reverse reaction of neutralization. Cf. *hydrogenolysis*.

**hydrolyst** A catalyst causing hydrolysis; as, a hydrolase.

**hydrolyte** A substance that undergoes hydrolysis.

**hydrolytic** Pertaining to hydrolysis. h. condensation An erroneous term applied to condensations in which water is eliminated. h. dissociation (1) See *dissociation*. (2)

**Hydrolysis.** h. enzymes See *hydrolytic enzymes* under *enzymes*.

**hydrolyze** To cause hydrolysis.

**hydromagnesite**  $3\text{MgCO}_3 \cdot \text{Mg}(\text{OH}_2) \cdot 3\text{H}_2\text{O}$ . A chalklike magnesium carbonate from Lodi, N.J.

**hydromechanics** Hydraulics.

**hydromel** A fermented (mead) or unfermented mixture of water and honey.

**hydrometallurgy** The recovery of metals from primary ores, concentrates, or secondary materials by processes based on aqueous solution chemistry. See *leaching*.

**hydrometer** Aerometer. A device to measure the specific gravity of liquids. Usually a graduated, hollow, weighted

glass tube which sinks in the liquid to a certain depth which, read on the scale, indicates the specific gravity of the liquid. Sikes ~ A hydrometer in which 1 degree equals a mean specific gravity interval of 0.002.

**h. scales** The graduations on a h.; as, Baumé, Twaddle, Beck, Brix, Balling, and Sikes. Conversion of:

$${}^{\circ}\text{Bé to } d: d = \frac{144.3}{144.3 \pm \text{Bé}}$$

$${}^{\circ}\text{Tw to } d: d = 1 + \frac{\text{Tw}}{200} = 1 + 0.005\text{Tw}$$

$${}^{\circ}\text{Brix to } d: d = 1 \pm \frac{400}{\text{Brix}} \text{ at } 15.6^{\circ}\text{C}$$

$${}^{\circ}\text{Balling to } d: d = 1 \pm \frac{200}{\text{Balling}} \text{ at } 17.5^{\circ}\text{C}$$

( $d$  = specific gravity)

See *API gravity* under *gravity*.

**Hydron** Trademark for polyhydroxyethylmethacrylate. Used for contact lenses and artificial skin.

**hydronal** Polychloral, viferral. A polymerized product of pyridine and chloral; a hypnotic.

**hydronaphthoquinone**  $\text{C}_{10}\text{H}_8\text{O}_2 = 160.2$ . 1,2-~ Colorless leaflets, m.60, soluble in water. 1,4-~ Colorless needles, m.175, soluble in water.

**hydrone** (1) An alloy: Na 35, Pb 65%; used to make hydrogen gas by the action of water. (2) The active molecule  $\text{H}_2\text{O}$ . h. theory Water is a complex mixture of active molecules: hydrone,  $\text{H}_2\text{O}$ ; hydrol,  $\text{H}_2\text{O}_2$ ; and inactive or associated molecules, polyhydrones,  $\text{H}_{2n}\text{O}_n$ .

**hydronitric acid** Hydrogen azide\*.

**hydronitrogens** Nitrogen hydrides.

**hydronitrous acid** Nitroxylic acid\*.

**hydronium ion** The protonated water molecule, or solvated hydrogen ion,  $\text{H}_3\text{O}^+$ . Cf. *protophilic*.

**hydroperoxide\*** An organic compound containing an  $-OO$  group, e.g., as formed in the oxidation of rubber. Hydroperoxides have oxidizing properties.

**hydrophane** A transparent opal.

**hydrophile** Lyophile. A substance, usually a colloid or emulsion, which is wetted by water.

**hydrophilic** (1) Lyophilic. Describing a substance that readily associates with water. Antonym: hydrophobic. (2) Protophilic. h. colloid Finely divided particles forming stable suspensions in water. Antonym: hydrophobic colloid.

**hydrophilite**  $\text{CaCl}_2$ . Native calcium chloride (chlorocalcite), occurring as white incrustations on Mt. Vesuvius.

**hydrophobe** Lyphobe. A substance, usually colloidal, which is not wetted by water.

**hydrophobic** Describing a substance that does not adsorb or absorb water. Antonym: hydrophilic. h. colloid Finely divided, suspended particles in water which precipitate readily.

**hydropirin** Sodium acetyl salicylate.

**hydropolsulfide\*** Polysulfane\*. Compounds of the type  $\text{R}-\text{S}_2\text{H}$ ,  $\text{R}-\text{S}_3\text{H}$ ,  $\text{R}-\text{S}_n\text{H}$ ; as, ethyl hydrodisulfide or ethyl disulfide, EtSSH.

**hydroponics** Tank culture. The cultivation of plants in aqueous solutions of inorganic salts, without soil. See *water culture*.

**hydroquinine**  $\text{C}_{20}\text{H}_{26}\text{O}_{22} \cdot 2\text{H}_2\text{O} = 654.5$ .

Methylhydrocupreine. White crystals; a quinine substitute in malaria, developer in photography, and reducer in chemical analysis.

**hydroquinol** Hydroquinone\*.

**hydroquinone\***  $\text{C}_6\text{H}_4(\text{OH})_2 = 110.1$ . p-Dihydroxybenzene\*, 1,4-benzenediol†, (hydro)quinol. White needles, m.174,

**supercarbonate** Hydrogencarbonate\*.

**superchlorination** Sterilizing water by chlorinating in excess, and then adding an antichlor.

**superconductivity** Supraconductivity. The property of some elements of becoming particularly good electrical conductors at temperatures below about 11 K; e.g.: Pb 7.2, Hg 4.2, Sn 3.7, In 3.4, Tl 2.4 K. **s. motor** A device utilizing the s. of copper to produce considerable reductions in the size and weight of conventional electric motors.

**supercooled** Over- or undercooled. Cooled below the freezing point of a liquid without the separation of solid matter.

**superfluid** Supafuid. A fluid having exceptionally good heat-transfer and penetrating properties, e.g., liquid helium<sub>II</sub>. **Supergas** Trademark for triptane.

**superheated** Overheated. Describing a liquid or gas heated above its boiling point in the liquid state; as superheated steam (water vapor at above 100°C).

**supermalloy** The alloy Ni 75, Mo 5, Fe + Mn 20%. It has a high magnetic permeability; used in transformer cores.

**supernatant** Describing the liquid above a sediment or precipitate.

**supernickel** The alloy Cu 70, Ni 30%; retains its strength at high temperatures.

**supernormal** A volumetric solution of concentration greater than normal.

**superoxide** Hyperoxide\*.

**superpalite** A poison gas. Cf. *palite*.

**superphosphate** (1) An acid phosphate. (2) A fertilizer mixture of calcium phosphate and calcium sulfate obtained by the action of concentrated sulfuric acid on phosphate minerals (apatite, phosphorite). **ammoniated** ~ See *ammoniated superphosphate*. **double** ~ A fertilizer made by the action of phosphoric acid on rock phosphate (40–50% phosphorus pentaoxide).

**superpolymer** A polymer whose molecular weight exceeds 10,000.

**superpotential** Overvoltage.

**supersaturated** More than saturated. **s. solution** A solution containing an excess of dissolved substance over that normally required for saturation at a particular temperature, obtainable by slowly cooling a saturated solution.

**supersolubility** Supersaturation. **s. curve** The curve relating the concentration of a supersaturated solution with the temperature; analogous to and parallel with the *solubility curve*, q.v.

**supersonic** Describing speed or velocity greater than that of sound. Cf. *ultrasonic*.

**supersteel** A high-speed steel, q.v.

**supertension** Overvoltage.

**suppository** Pharmaceutical term for a medicated, conical body for insertion into the rectum.

**suppurative** An agent that produces pus.

**supra-** Prefix (Latin) indicating "above."

**supraconductivity** Superconductivity.

**Supramid** Trademark for a polyamide synthetic fiber.

**suprarenal gland** Adrenal gland. A gland above the kidney.

**suprarenaline** Adrenaline.

**suprasterols** Sterols produced by irradiation of lumisterol. **s. II**  $C_{28}H_{44}O = 396.7$ . **m.110**.

**Suprema** Trademark for a viscose synthetic fiber.

**Supron** Trademark for a polyamide synthetic fiber.

**suramin sodium** ~  $C_{51}H_{34}O_{23}N_6S_6 = 1291$ . Bayer 205. Germanin. Bitter, hygroscopic powder, insoluble in ether; a urea complex, used to treat African trypanosomiasis.

**surcharge** The sum of the errors involved in an assay.

**surface** The outer part of a body having length and breadth but not thickness. **s.-active agent** See *surfactant*. **s. charge density\*** The electric charge per unit surface area. Cf. *current density*. **s. energy** The product obtained by multiplying surface tension by the two-thirds power of the molecular weight and specific volume. **s. tension\*** The contractile surface force of a liquid which makes it tend to assume a spherical form, e.g., to form a meniscus. It also exists at the junction of 2 liquids. It is measured directly ( $1 \text{ mN/m} = 1 \text{ dyne/cm}$ ) or indirectly by determining the capillarity. The s. t. (at constant temperature)  $\gamma$  is in a constant ratio to the 4th power of the orthobaric densities of liquid  $D$  and gas  $d$ ; hence  $\gamma = K(D - d)^4$ . Cf. *parachor*. **s. tension apparatus** Tensiometer. A device for determining the s. t., based upon the flexibility of a wire.

**• surfactant** A surface-active agent; i.e., one that modifies the nature of surfaces, this often involving reducing the surface tension of water. Widely used as wetting agents, detergents, emulsifiers, dispersing agents, penetrants, and antifoams. Four types: cationic (as, modified onium salts); anionic (alkylarylsulfonates); nonionic (polyethylene oxides), and ampholytic (dodecyl-β-alanine).

**surfusion** The unstable condition of a liquid cooled below its freezing point without solidifying. Cf. *supercooled*.

**surpalite** Diphosgene.

**surrogate** A substitute for another substance; as, margarine for butter.

**surrosion** The increase in weight of a substance due to corrosion.

**susceptible** Sensitive. Readily capable of responding to an action or force; as, magnetic susceptibility. Cf. *immune*.

**susotoxin**  $C_{10}H_{26}N_2 = 174.3$ . Sustoxin. A ptomaine from cultures of hog cholera bacillus.

**suspension** (1) Suspensoid. (2) A thin thread on which the mirror and magnet of a galvanometer hang. **s. method** The determination of the density of a solid by placing it in a solution of known density. See *density fluids*.

**suspensoid** Suspension, soliquoid. Finely divided colloidal particles floating in a liquid, too small to settle, but kept in motion by Brownian motion.

**sussexite** A native, hydrated magnesium manganese diborate.

**sustoxin** Susotoxin.

**Sutherland** S.-Einstein equation  $D = RT/Lf$ , where  $D$  is the diffusion constant,  $R$  the gas constant,  $T$  the thermodynamic temperature,  $L$  the Avogadro constant, and  $f$  the frictional force on each molecule having unit velocity. S.'s formula The viscosity of a gas ( $\eta$ ) at thermodynamic temperature  $T$  is given from that at 0°C ( $\eta_0$ ) by:  $\eta = \eta_0(T/273.15)^{3/2} \times (k + 273.15)/(k + T)$ , where  $k$  is the S. constant.

**suture** A stitch, or the operation of stitching, or the s. material, used in surgery. **absorbable** ~ A sterile s. prepared from the intestine of healthy animals (USP).

**nonabsorbable** ~ A s. that resists enzyme digestion in living animal tissues, e.g., of stainless steel.

**suxamethonium chloride** BP name for succinylcholine chloride.

**Sved** A unit of sedimentation rate.

**Svedberg** S., Theodor (1884–1971) Swedish physical chemist, Nobel prize winner (1926); noted for research on colloids. S.'s equation The amplitude  $A$  of Brownian movement of a particle is proportional to its vibration period  $t$ . S. unit Abbrev. S; used in sedimentation; equal to  $10^{-13}$  seconds.

**swage** To fashion metal, particularly iron, by drawing it into a groove, mold, or die having a desired shape.

TABLE 40. The Greek Alphabet

A	$\alpha$ (a)	alpha ( <i>al'-fah</i> )	a
B	$\beta$	beta ( <i>be'-tah</i> )	b
Γ	$\gamma$	gamma ( <i>gam'-ah</i> )	g (hard)
Δ	$\delta$ (ð)	delta ( <i>de'-tah</i> )	d
Ε	$\epsilon$ (e)	epsilon ( <i>ep'-si-lon</i> )	e (short)
Ζ	$\zeta$	zeta ( <i>za'-tah</i> )	z
Η	$\eta$	eta ( <i>et'-ah</i> )	e (long)
Θ	$\theta$ (ð)	theta ( <i>tha'-tah</i> )	th
I	$\iota$	( <i>i'-tah</i> )	i
K	$\kappa$ (x)	kappa ( <i>kap'-ah</i> )	k
Λ	$\lambda$	lambda ( <i>lam'-dah</i> )	l
M	$\mu$	mu ( <i>mu</i> )	m
N	$\nu$	nu ( <i>nu</i> )	n
Ξ	$\xi$	xi ( <i>zi</i> )	x
Ο	$\ο$	omicron ( <i>o'-mi-kron</i> )	o (short)
Π	$\pi$	pi ( <i>pi</i> )	p
P	$\rho$	rho ( <i>ro</i> )	r
Σ	$\sigma$ (s)	sigma ( <i>sig'-mah</i> )	s
T	$\tau$	tau ( <i>tau</i> )	t
Τ	$\upsilon$	upsilon ( <i>up'-si-lon</i> )	u
Φ	$\phi$ (φ)	phi ( <i>fi</i> )	ph (f)
X	$\chi$	chi ( <i>ch</i> )	ch (as in loch)
Ψ	$\psi$	psi ( <i>ps</i> ; <i>si</i> )	ps
Ω	$\omega$	omega ( <i>o-me'-gah</i> )	o (long)

greisen A granite in which feldspar is replaced by quartz. Grenacher stain Carmines of alum, borax, and hydrochloric acid, used to stain nucleic and muscle tissues.

Grenet battery An electrolytic carbon-zinc cell.

grenz rays Infraroentgen rays, Bucky rays, long-wave X-rays. Very soft X-rays produced at low voltages and absorbable by glass; used to treat skin diseases. Cf. radiation.

grey See gray.

GRI Abbreviation for government rubber-isobutene; a synthetic rubber. Cf. GRS.

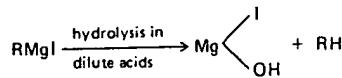
Griess, Peter (1829-1888) German-born British chemist. G. reaction The substitution of amino radicals by hydroxy, halogen, or nitrile radicals by diazotization and treatment with water. G.-Ilosva reagent A solution of sulfanilic acid and 1-naphthylamine in acetic acid; a reagent for nitrites.

Griffith G. white Lithopone. G. cracks Surface flaws in glass.

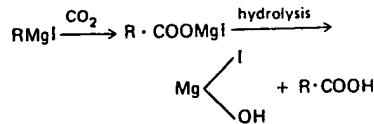
Grignard, Victor (1871-1935) French chemist. Nobel prize winner (1912). G.'s reaction Magnesium alkyl condensation: a reaction by which a C atom is introduced into the hydrocarbon radical or a compound by G.'s reagent to pass from a lower to a higher member of a homologous series. G.'s reagent Compounds of the general type  $R \cdot Mg \cdot X$ , where R is an organic radical, and X a halogen.

Typical Grignard reactions:

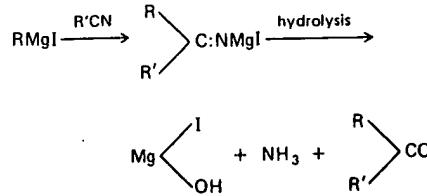
1. Formation of a hydrocarbon.



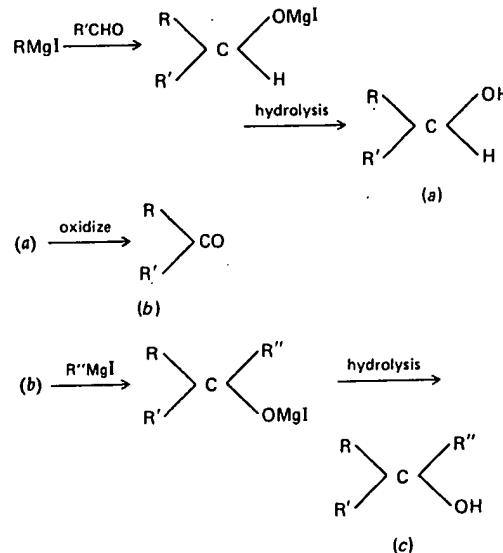
2. Preparation of an acid.



### 3. Preparation of a ketone.



### 4. Preparation of (a) a secondary alcohol, (b) a ketone, or (c) a tertiary alcohol. Polaies reaction:



Grilon Trademark for a polyamide synthetic fiber.

grinding The process of powdering a substance by lateral motion, as opposed to perpendicular motion (crushing).

graphite  $8[(NaAlCaFe)_3Mn(PO_4)_2 \cdot 5(OH)_2]$ . A native, garnet-type hydroxylphosphate.

griseofulvin  $C_{17}H_{17}O_6Cl = 352.8$ . Fulcin, Fulvicin, Grisovin. Cream powder produced by *Penicillium griseofulvum*, slightly soluble in water; an antifungal for skin and nails (USP, BP).

Grisovin Trademark for griseofulvin.

grit See particulate.

grog Broken bricks, or burnt, ground fireclay; a refractory. Grossmann reagent  $(C_2H_6ON_4)_2H_2SO_4$ . An ammoniacal solution of dicyanodiamidine sulfate; yellow precipitate with nickel.

grossularite A green calcium aluminum garnet.

Grotthus' law Radiation must be absorbed to produce a reaction.

ground (1) Powdered. (2) Earth. A conducting path between an electric circuit or equipment and the earth. (Also, to create such a path.) gnut Arachis. gnut oil Arachis oil. g.state' The normal or unexcited state of an atom. g.wood A form of mechanical wood pulp.

group (1) A number of elements having similar properties, e.g., the alkali metals. See periodic table under periodic. (2) A number of atoms that pass through a series of reactions

unseparated. See radical. (3) A number of elements with similar reactions. See qualitative analysis under analysis. characteristic ~ An atom or g. that is incorporated into a parent compound other than by a direct carbon-carbon linkage, but including groups  $-CN$  and  $=C:X$ , where X is O, S, Se, Te, NH, or substituted NH. It includes g. such as  $-OH$ ,  $-NH_2$ ,  $-COOH$ , single atoms (as, halogen),  $=O$ , N, and substituents such as piperidino and acetyl. It does not apply to substituents such as Me, Ph, 2-pyridyl. negative ~ A negatively ionized group, as  $SO_4^{2-}$ . See substitutive nomenclature in Table 56 under nomenclature. positive ~ A positively ionized g. of a metal or radical, as  $NH_4^+$ . principal ~\* The characteristic group chosen for expression as suffix in a particular name.

g. precipitant A reagent that precipitates elements of the same group, e.g., hydrogen sulfide. g. properties The properties of elements belonging to the same g., e.g., of a vertical division of the periodic table. g. reaction The precipitation of elements in a definite analytical g. Cf. precipitant.

Grove, Sir William Robert (1811-1896) British scientist. G.'s cell A voltaic cell (1.91 volts) of amalgamated zinc in sulfuric acid (d.1.136) and platinum in concentrated nitric acid.

growth An increase in size. bacterial ~ The appearance of a bacterial colony after incubation. inorganic ~ The aggregation of solid particles, by crystallization, periodic precipitation, or colloidal growth. g. hormone A hormone secreted by the anterior pituitary gland, that influences growth in children and protein metabolism in adults.

GRP See glass fiber-reinforced plastics. GRS Abbreviation for government rubber-styrene (U.S. usage). See SBR.

grumose Clotted.

grundy Granulated pig iron.

grunerite  $Fe_3H_2(SiO_3)_8$ , from Massachusetts.

glyrolite  $CaO \cdot 3SiO_2 \cdot 2H_2O$ . A constituent of certain boiler scales. Cf. cryolite.

G salt The sodium or potassium salt of G acid.

guachamacine Gauchamacine. An alkaloid from guachamaca, the bark of *Malouetia nitida* (Apocynaceae), Venezuela; an arrow poison.

gauthethol Thanatol.

guaiac A resin from *Guaiacum officinale* (Zygophyllaceae), S. America. g. resinic acid  $C_{20}H_{26}O_4 = 330.3$ . An acid of guaiac; yellow crystals. g. wood Lignum vitae, guaiaci lignum. The heartwood of *Guaiacum* species; a dye. g. wood oil The essential oil of g. d.0.965-0.975, soluble in alcohol. It contains 2-methyl-2-butenal\*. g. yellow The coloring matter of guaiac wood; yellow crystals.

guaiacene  $C_5H_8O = 84.1$ . 2-Methyl-2-butenal\*. An oil from the distillation of guaiac wood.

guaiacol Guaiac wood.

guaiacin  $C_{14}H_{24}O = 208.3$ . An alcohol, the odorous principle of balsam wood. Colorless crystals, m.91, soluble in alcohol; used in perfumery.

guaiacol\*  $C_6H_5(OH)OMe = 124.1$ . 2-Methoxyphenol†, methylpyrocatechin; in wood tar. Colorless prisms, m.32, soluble in water. A reagent to detect lignin, narceine, chelidonine, nitrous acid, and acacia. allyl ~ 4~ Eugenol\*. 5~ Chavbetol. methyl ~ Creosol. propenyl ~ Isoeugenol. vinyl ~ Hesperetol.

g. acetate  $C_9H_{10}O_3 = 166.2$ . Eucol. A liquid, b.238. g. carbonate  $(C_7H_7O_2)CO_3 = 274.3$ . White crystals, m.87, soluble in ether; a substitute for g. oleate. g. oleate Oleoguaiacol. A mixture of g. and oleic acid in ether.

guaiaconic acid  $C_{10}H_{24}O_5 = 244.3$ . A resinous acid, from guaiac. Brown powder; used in the guaiac test for blood.

guaiacum Guaiac.

guaiacyl The 2-methoxyphenyl\* radical.

guaiene  $C_{15}H_{24} = 204.4$ . Oils.  $\alpha \sim b.78$ .  $\beta \sim b.138$ ; from guaiac.

guaiol Champacol.

guaj- Variant of guai-.

guajene Guaiene.

guanamine  $CH:N \cdot C(NH_2):N \cdot C(NH_2):N = 111.1$ . 2,3-

Diamino-1,3,5-triazine. m.325. acet ~  $C_4H_7N_5 = 125.1$ . Colorless crystals, m.265.

guanase Guanine deaminase\*.

guanazyl The radical  $-N:NC(:N \cdot NH \cdot CNH \cdot NH_2)-$ . g. benzene  $Ph_2C_2H_4N_6 = 266.3$ . Colorless crystals, m.199.

guanethidine  $C_{10}H_{22}N_4 \cdot H_2SO_4 = 296.4$ . Ismelin. White crystals, m.254, soluble in water; a sympatholytic. g. sulfate  $(C_{10}H_{22}N_4)_2 \cdot H_2SO_4 = 494.7$ . White crystals, soluble in water; used as an antihypertensive and for eye conditions in thyrotoxicosis and glaucoma (USP, EP, BP).

guanidine\*  $(NH_2)_2C:NH = 59.1$ . Carbamidine, carbondiamide imide, uramine. Colorless crystals, soluble in water; an isolog of urea. aminobutyl ~ Agmatine.

benzoylene ~ See benzoylene guanidine. bi ~\*  $(H_2N \cdot C(NH_2))_2NH = 116.1$ . m.130. carbamoyl ~

$HN:C(NH_2)NHCONH_2 = 102.1$ . Prisms, m.110.

Amidinourea, dicyandiamidine, param. Colorless crystals, m.205. diphenyl ~ See diphenylguanidine under diphenyl. guanyl ~ Biguanidine\*. isopentyl ~ Galegine. lactoyl ~ Alacreatine. nitro ~  $CH_4O_2N_4 = 104.1$ . Colorless crystals, m.240.

g. phosphoric acid Phosphagen.

guanidines\* Compounds derived from guanidine, e.g., containing the radical  $=N \cdot C(NH) \cdot N=$ . See creatine.

guanidinium\* Describing a salt from guanidine with the g. cation,  $C(NH_2)_3^+$ , or its derivatives.

guanidino\* (Aminoiminomethyl)amino†, guanidino. The radical  $NH_2 \cdot C(NH) \cdot NH-$ , from guanidine. g. phosphoric acid Phosphagen. g. propanoic acid Alacreatine.

guanido The guanidino\* radical.

guanine  $C_5H_5ON_5 = 151.1$ . Imidoxanthine, 2-amino-6-oxopurine, 2-aminohypoxanthine. In guano, fish scales, human liver, and spleen. Colorless needles, decomp. above 360, insoluble in water. g. deaminase\* Guanase. An enzyme converting g. into xanthine; in adrenals and pancreas.

guanite Struvite.

guano Bird manure. The partly decomposed excrements of sea birds from the islands off the western coast of S. America, especially Peru; an excellent fertilizer and a source of guanine.

guanoline  $C_4H_9O_2N_3 = 131.1$ . Guanidinoformic ethyl ester. Colorless crystals, m.114.

guanosine  $C_{10}H_{13}N_5O_5 = 283.2$ . Vernine. A nucleoside in the pancreas. g. phosphoric acid Guanylic acid.

guanyl The amidino\* radical.

guanylic acid  $H_2PO_4 \cdot C_5H_7O_4 \cdot C_5H_4ON_5 = 378.2$ . A nucleic acid containing guanosine; in pancreas, ox liver, and yeast.

guar *Cyamopsis tetragonoloba*. An Indian plant resembling soya, grown in the U.S. The seeds are a source of g. gum, a mannogalactan mucilage. g. gum An emulsifier, stabilizer, and thickening agent in pharmacy (NF).

guarana tannin Paullinia tannin.

guarantine Caffeine.

guard tube A tube which usually contains calcium chloride, to prevent access of atmospheric moisture to gas absorption bulbs during weighing. Cf. witness.

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# INTRODUCTION TO PHYSICAL POLYMER SCIENCE

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SECOND EDITION

L. H. Sperling  
Lehigh University  
Bethlehem, Pennsylvania



A WILEY-INTERSCIENCE PUBLICATION

**JOHN WILEY & SONS, INC.**

New York / Chichester / Brisbane / Toronto / Singapore

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Table 2.7 Specialized nomenclature terms (19)

*Link*—A covalent chemical bond between two monomeric units, or between two chains.

*Chain*—A linear polymer formed by covalent linking of monomeric units.

*Backbone*—Used in graft copolymer nomenclature to describe the chain onto which the graft is formed.

*Side chain*—The grafted chain in a graft copolymer.

*Cross-link*—A structure bonding two or more chains together.

*Network*—A three-dimensional polymer structure, where (ideally) all the chains are connected through cross-links.

*Multicomponent polymer, multipolymer, and multicomponent molecule*—General terms describing intimate solutions, blends, or bonded combinations of two or more polymers.

*Copolymer*—Polymers that are derived from more than one species of monomer.

*Block*—A portion of a polymer molecule in which the monomeric units have at least one constitutional or configurational feature absent from the adjacent portions.

*Block copolymer*—A combination of two or more chains of constitutionally or configurationally different features linked in a linear fashion.

*Graft copolymer*—A combination of two or more chains of constitutionally or configurationally different features, one of which serves as a backbone main chain, and at least one of which is bonded at some point(s) along the backbone and constitutes a side chain.

*Polymer blend*—An intimate combination of two or more polymer chains of constitutionally or configurationally different features, which are not bonded to each other.

*Conterminous*—At both ends or at points along the chain.

*Conterminously linked copolymer*—A polymer chain that is linked at both ends to the same or to constitutionally or configurationally different chain or chains; a polymer cross-linked by a second species of polymer.

*Interpenetrating polymer network*—An intimate combination of two polymers both in network form, at least one of which is synthesized and/or cross-linked in the immediate presence of the other.

*Semi-interpenetrating polymer network<sup>a</sup>*—A combination of two polymers, one cross-linked and one linear, at least one of which was synthesized and/or cross-linked in the immediate presence of the other.

*Star polymer*—Three or more chains linked at one end through a central moiety.

*Star block copolymer*—Three or more chains of different constitutional or configurational features linked at one end through a central moiety.

<sup>a</sup>Also called a pseudo-interpenetrating polymer network. See D. Klempner, K. C. Frisch, and H. Frisch, *J. Elastoplastics*, 5, 196(1973).

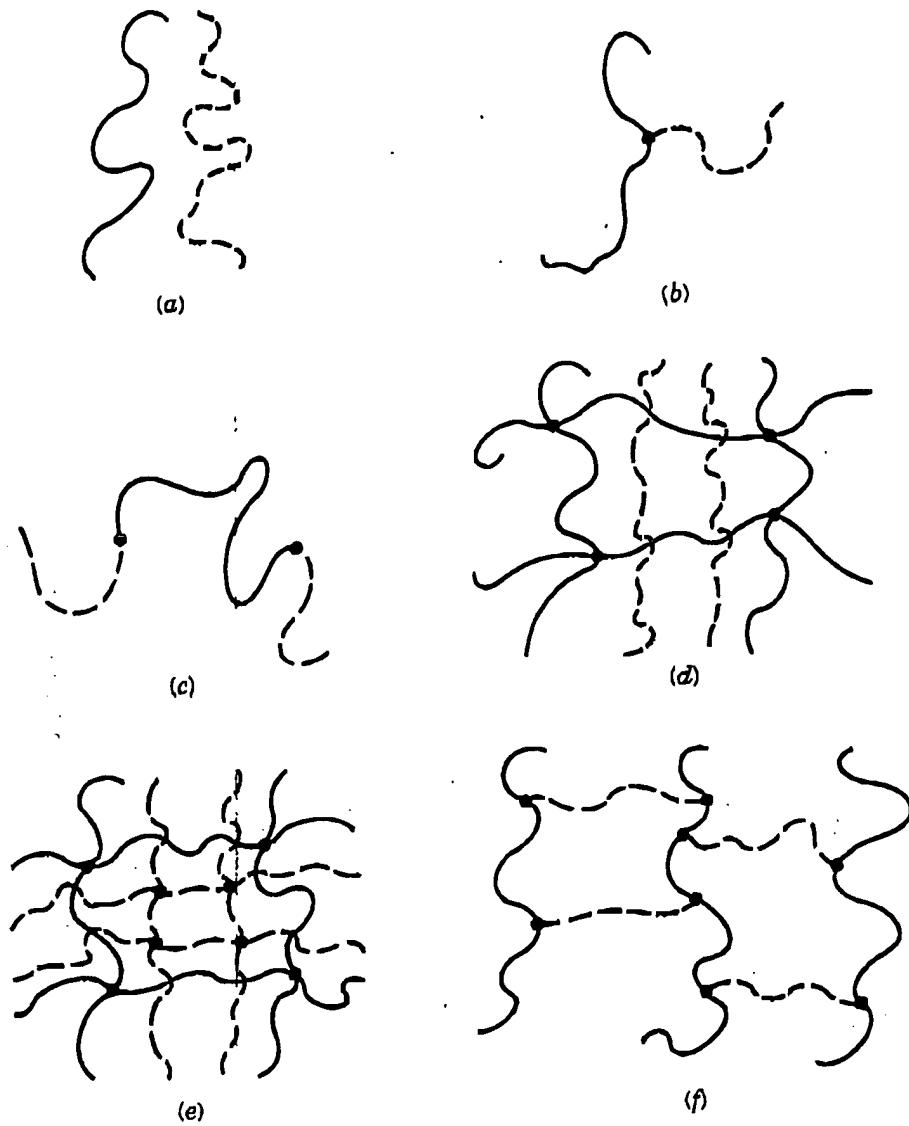


Figure 2.9 Six basic modes of linking two or more polymers are identified (19). (a) A polymer blend, constituted by a mixture or mutual solution of two or more polymers, not chemically bonded together. (b) A graft copolymer, constituted by a backbone of polymer I with covalently bonded side chains of polymer II. (c) A block copolymer, constituted by linking two polymers end on end by covalent bonds. (d) A semi-interpenetrating polymer network constituted by an entangled combination of two polymers, one of which is cross-linked, that are not bonded to each other. (e) An interpenetrating polymer network, abbreviated IPN, is an entangled combination of two cross-linked polymers that are not bonded to each other. (f) A contuminously linked polymer, constituted by having the polymer II species linked, at both ends, onto polymer I. The ends may be grafted to different chains or the same chain. The total product is a network composed of two different polymers.